REMARKS

This is in full and timely response to the Office Action dated June 27, 2002 (Paper No. 04). Reexamination and reconsideration are respectfully requested.

Priority Claim

It was noted with appreciation that the certified copy in support of the priority claim is not yet on file. A copy of that document has been requested and will be provided as soon as possible. The absence of the priority document does not affect either of the cited and applied references.

Drawings

It is noted that the drawings filed with the application on June 7, 2001 are accepted. Further consideration by the Examiner as to whether the explanatory Fig. 12, discussed in the Background of the Invention should be labeled as "Prior Art".

Specification

The specification has been reviewed in addition to the thorough review by the Examiner. Changes are made to the specification to attend to those matters of the Examiner. The thoroughness of that review is also acknowledged with appreciation.

Objection to the Specification

The specification had been objected to for failing to support language in claim 6 referring to "an aerial image". Because of the way the response is structured, claim 6 is canceled. However, in the event that reinstatement is necessitated in subsequent prosecution, it should be noted that an aerial image is designated by numeral 40 in the figures, and refers to a superposed image of images that are displayed on the LCD 38. It is the type of image that is seen when one looks into a microscope, i.e. an image that is not projected on a screen, but rather is presented in the middle of a space. In the invention, it should be noted that the superposed image is not separated into a plurality of images; rather it is a single image in which a plurality of images displayed in the LCD are superposed in a single spatial area.

Claim Objections

Claims 2 to 9 were objected to for the informalities stated in section 4 on page 3 of the Action. Claim 6 is canceled; otherwise, each of the objections is overcome by amendment to the claims. For example, amendments to the preamble of claim 1 provide antecedent basis for the limitation in claims 4 and 5.

Claims 1 to 4, and 6 to 12 were initially rejected as allegedly being anticipated by the patent to Chen, No. 4,783,133 (1988) (hereafter Chen '133).

Claim 5 was initially rejected as allegedly being unpatentable over Chen '133 in view of Brooks, No. 4,082,435.

These rejections are respectfully traversed and reexamination and reconsideration are requested in view of the amendments to the claims; those amendments are made without acquiescence in or agreement with the rejections posed, but rather are to expedite prosecution of this application.

It will helpful to the Examiner to set the table for an understanding of the invention to review how to create a holographic stereogram as discussed on pages 1 and 2 of the specification, referring to Fig. 12. A plurality of images are sequentially recorded on a single holographic recording medium, wherein the holographic stereogram has parallax information in a horizontal direction only. A subject 100 is sequentially photographed to produce a plurality of original images 101a to 101e and each is sequentially recorded on a holographic recording medium 102 to generate the holographic stereogram. When an observer views the two-dimensional images on this medium with both eyes, the observer feels, or visually senses, parallax, reproducing a three-dimensional image.

In this respect, it is not clear that Chen in fact relates to a stereographic hologram as claimed. Rather, Chen discloses production of rainbow holograms from photographs taken in incoherent light with a lenticular lens array to produce parallax information. Moreover, Chen does not disclose an object optical

system as in the present invention since it is not clear how Chen's exposure apparatus could create a single superposed image of images before condensing light beams as in the present invention. These general observations and background aside, we turn now to the claimed invention, as amended.

The present invention as claimed in claim 1, as amended, projects only a limited number of the images on the hologram recording medium. More specifically, the number of images projected on the hologram recording medium is less than the total number of parallax images included in a single holograph stereogram (see section 0048 on page 12 of the disclosure). Each of the sections divided in the LCD displays a parallax image, and such parallax image corresponds to an element hologram that constitutes the holograph stereogram. Thus, the present invention reduces production time for a holographic stereogram (see sections 0002 to 0006). Conventionally, only a one element hologram is exposed in a single exposure process. The present invention thus enables exposure of a plurality of the element holograms in a single exposure.

It is submitted that the amendments to independent claims 1 10 and 12 distinguish over Chen.

While it is true that Chen uses a construction in which a plurality of parallax images are exposed to produce a hologram, and at first consideration seems to have a similar construction, in Chen, all of the parallax images are exposed in a single exposure. The series of adjacent images having sequentially differing viewpoints of an object is created by a compound lens

unit (see column 6, lines 5 et seq. and column 7, lines 10 to 34). No indication or suggestions is found in Chen to provide a plurality of images used to form a holographic stereogram image, as in the Applicant's claimed invention. Moreover, Chen has no indication or awareness of a need to reduce the exposure time since the exposure system is totally different from the present invention.

Dependent claims 2 to 5, and 7 to 9, dependent on or through claim 1 are thus patentable for at least the foregoing reasons, and in their own right. However, to the limited extent that the stated rejection might also be still applied to claim 5, it should be noted that there is an insufficient reason or suggestion to make the combination. The reasons advanced by the Examiner are at best the result of the modification, not a reason for making it.

Method claim 10 refers to the same distinguishing features as does the image generation systems of claim 12. Early notice of allowance is respectfully requested.

Respectfully submitted,

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Ronald P. Kananen
Registration No. 24,104

RADER, FISHMAN & GRAUER, PLLC
Lion Building
1233 20th Street, N.W.
Washington, D.C. 20036
Tel: (202) 955-3750
Customer No. 23353

APPENDIX I
SPECIFICATION AMENDMENTS

Please replace the paragraph beginning on page 1, line 25, and continuing on page 2 with the following new paragraph:

Meanwhile, the hologram exposure is very sensitive to vibrations. During the exposure time, an optical system must not vibrate on a recording wavelength scale. As mentioned above, however, a holographic stereogram may be generated by exposing thin slit element holograms one by one. In this case, it is necessary to wait until a vibration attenuates between exposures to some extent. This has been a hindrance to shorten the time to generate holograms. Since only the inside of an element hologram is exposed, the other beams are discarded as unnecessary beams. After all, this increases the total exposure time and requires a costly, high-power laser, causing unfavorable effects.

Please replace the paragraph beginning on Page 4, line 13, with the following new paragraph:

[Fig. 3 is] Figs. 3A and 3B are a detail view showing a reference optical system in the holographic stereogram exposure apparatus.

Please replace the paragraph beginning on Page 4, line 19, with the following new paragraph:

[Fig. 6 is] Figs. 6A and 6B are a partial diagrammatic view showing an optical path in the superposed projection optical system.

Please replace the paragraph beginning on Page 4, line 23, with the following new paragraph:

[Fig. 8 is] Figs. 8A and 8B are a detail view showing a beam-condensing projection optical system constituting the object beam optical system.

Please replace the paragraph beginning on Page 5, line 14, with the following new paragraph:

This embodiment provides a system for generating a so-called one-step holographic stereogram. This means that a hologram recording medium records an interference pattern of [objects] object beams and reference beams and is used as a holographic stereogram as is. As shown in FIG. 1, the system comprises a data processing section 1, a control computer 2, and a holographic stereogram exposure apparatus 3. The data processing section 1 processes image data to be recorded. The control computer 2 controls the entire system. The holographic stereogram exposure apparatus 3 uses an optical system for holographic stereogram exposure to expose 3-D image information to a hologram recording medium.

Please replace the paragraph beginning on Page 7, line 21, and continuing on page 8 with the following new paragraph:

The reference beam L4 is split by the beam splitter 34 and is reflected on the mirror 43. For interference with the object beam L3 on the hologram exposure face (hologram recording medium

42), the reference beam optical system 44 changes the reference beam L4 to a specified element hologram size and projects it on the hologram recording medium 42. [FIG. 3 shows] Fig. 3A and 3B show an example of the reference beam optical system 44. FIG. 3A is a top view and FIG. 3B is a side view thereof. The following describes an example of generating a holographic stereogram comprising an element hologram of 0.2 mm wide (d) and 30 mm long (L). The reference beam L4 entering a cylindrical lens 51 is spread only in the horizontal direction and then enters a collimating cylindrical lens 52 to be formed to a parallel beam. As will be described later in detail, the reference beam L4 as a parallel beam passes through a slit 53 (D x L = 5d x L = 5 x 0.2 mm x 30 mm). The slit 53 is telecentrically projected on the surface of the hologram recording medium 42 by means of a first cylindrical lens 54 and a second cylindrical lens 55 with the magnification of -1, producing a specified reference beam.

Please replace the paragraph beginning on page 8, line 9, with the following new paragraph:

The following describes the object beam optical system 35. It comprises an illuminating optical system 36 (described later), a spatial light modulation section 38, [an] a superposed projection optical system 39, and a beam-condensing projection optical system 41. The superposed projection optical system 39 superposes and projects the beam passing through the spatial light modulation section 38. With respect to a projected image from the superposed projection optical system 39, the beam-

condensing projection optical system 41 condenses a beam in the parallax direction and forms an image in the non-parallax direction on the surface of the hologram recording medium 42.

Please replace the paragraph beginning on page 9, line 15, and continuing on page 10, with the following new paragraph:

First, the parallax direction (side view) of the superposed projection optical system 39 is explained with reference to FIG. 5. After passing through the illuminating optical system 36, the laser beam evenly illuminates the face of the liquid crystal 38 in FIG. 5. The beam passing through the liquid crystal 38 reaches a lenticular lens 65 divided into five portions and then passes through the optical path as shown in this figure. This optical path is explained with reference to FIG. 6A to FIG. 6C. [In]FIG. 6A shows the entire optical path. FIG.6B shows an enlarged detail of the center of the optical path. FIG. 6C shows an enlarged detail of the bottom thereof. Each of five divisions of the superposed projection optical system 39 forms an image 40 to the right of a lens 66. Further, it is understood that images for the five divisions on the liquid crystal 38 are superposed on the same positions. When the liquid crystal 38 is divided into five portions, this optical system needs to have a projection magnification of 5 so that the same size is maintained between the image 40 for the liquid crystal 38 and the original image.

Please replace the paragraph beginning on Page 10, line 15 and continuing on page 11 with the following new paragraph:

The following describes the beam-condensing projection optical system 41 with reference to FIG. 8A and FIG.8B. FIG.8 A shows a side view. FIG. 8B shows a top view. This optical system condenses a beam for the liquid crystal's image 40 in the parallax direction (A) and forms this image in the non-parallax direction (B) on the surface of the hologram recording medium 42. This effect makes a holographic stereogram to be visible in 3-D. As shown in FIG. 8A and FIG. 8B, the beam-condensing projection optical system 41 uses a first lens 71 to project the liquid crystal's image 40 for passing through a slit 72 and uses a second lens 73 to let the beam enter a beam-condensing cylindrical lens 74. The beam-condensing cylindrical lens 74 condenses the image's beam in the parallax direction for entering the hologram recording medium 42 and forms the image in the non-parallax direction. The basic configuration of this optical system is the same as that of a conventional beam-condensing projection optical system except that the present invention uses a different value for the width of the slit 72. Conventionally, when an element hologram has a width of 0.2 mm, the slit width becomes 0.2 x 80/8.4 = 1.905 mm as seen from the figure. This is the slit width in the parallax direction, namely within the side view in FIG. 8A, providing no restrictions on the slit width within the top view.

Please replace the paragraph beginning on page 12, line 5, with the following new paragraph:

In this example, the hologram recording medium 42 is a hologram film wound [round] around a film cartridge 75. A recording medium feed mechanism (not shown) pulls the hologram recording medium 42 out of the film cartridge 75 and feeds it. The recording medium feed mechanism causes a vibration attenuation wait time, prolonging the time for generating holographic stereograms. By contrast, the holographic stereogram exposure apparatus in the above-mentioned holographic stereogram generation system can record a parallax image sequence comprising five element holograms at a time.
It is possible to decrease the number of vibration attenuation wait situations. In total, the time for generating holographic stereograms can be shortened.

Please replace the paragraph beginning on page 14, line 13, with the following new paragraph:

The slit 72 is provided between the first lens 71 and the second lens 73 in the beam-condensing projection optical system 41 shown in FIGS. 8 and 9 and in the beam-condensing projection optical system 41' shown in FIG. 11. Instead of using this slit, it may be preferable to provide a plurality of slits between the lenticular lens 65 and the lens 66 in the superposed projection optical system 39. Alternatively, it may be preferable to provide a partition between the 5-portioned liquid crystal 38 and the lenticular lens 65 so that the partition is parallel to the beams. In these cases, the beam-condensing projection optical system 41' should provide the correction

cylindrical lens 80 between the first lens 71 and the second lens 73.

APPENDIX II
CLAIM AMENDMENTS

1. (Amended) A holographic stereogram exposure apparatus for exposing [3-D] three-dimensional image information [to] on a hologram recording medium to produce a holographic stereogram, said apparatus comprising:

spatial light modulation means for separately displaying a plurality of images in a parallax direction, and

an object beam optical system [which superposes and] that projects light beams [passing] passed through [a] said plurality of images [separately] displayed [in a parallax direction and then] on said spatial light modulation means to form a superposed image of said plurality of images, and condenses [these beams] said superposed images to separately [to] project said plurality of images in said parallax direction on said hologram recording medium [corresponding to the number of separations], wherein

each of said plurality of images corresponds to a respective element hologram, and

the number of said plurality of images is less than the number of element holograms included in said holographic stereogram.

2. (Amended) The holographic stereogram exposure apparatus according to claim 1 [having] further including a reference beam optical system [which] that projects a reference beam onto said hologram recording medium for interference with said plurality of images projected on said hologram recording medium.

3. (Amended) The holographic stereogram exposure apparatus according to claim 1, wherein said object beam optical system comprises [spatial light modulation means for separately displaying a plurality of images in said parallax direction,] a superposed projection optical system for [superposing and] projecting said light beams passing through [this] said spatial light modulation means to form said superposed image, and a beam-condensing projection optical system for [converging a projected image from this superposed projection optical system onto a face of] condensing said superposed image to project said plurality of images onto said hologram recording medium.

4. (Amended) The holographic stereogram exposure apparatus according to claim 3, wherein [said object beam optical system divides] said spatial light modulation means is divided into [in a parallax direction so that said holographic stereogram has a parallax only in] a horizontal direction.

5. (Amended) The holographic stereogram exposure apparatus according to claim 3, wherein said [object beam optical system vertically and horizontally divides] said spatial light modulation means [so that said holographic stereogram has parallaxes in] is divided into both vertical and horizontal directions.

6. Cancel without prejudice or disclaimer.

7. (Amended) The holographic stereogram exposure apparatus according to claim [6]3, wherein said beam-condensing projection optical system [of said object beam optical system] projects [an image projected by said superposed projection optical system] said superposed image onto said hologram recording medium in a non-parallax direction and [converges this image] condenses said superposed image in a parallax direction.

8. (Amended) The holographic stereogram exposure apparatus according to claim [7] 3, wherein said beam-condensing projection optical system [of said object beam optical system] uses a first-group lens and a second-group lens to [allow an image projected by said superposed projection optical system to enter] guide said superposed image to a beam-condensing cylindrical lens.

9. (Amended) The holographic stereogram exposure apparatus according to claim 8, wherein said beam-condensing projection optical system [of said object beam optical system] is provided with a correction lens between said first-group lens and said second-group lens for correcting unevenness of the angle of field for each element hologram on said hologram recording medium.

10. (Amended) A holographic stereogram exposure method of exposing [3-D] three-dimensional image information onto a hologram recording medium to produce a holographic stereogram, said method comprising:

an object beam projection step for [superposing and] projecting light beams [passing] passed through a plurality of images separately displayed in a parallax direction to form a superposed image of said plurality of images, and [then] condensing [these beams] said superposed image to separately project said plurality of images on said hologram recording medium [corresponding to the number of separations] in said parallax direction; and

a reference beam projection step for projecting a reference beam onto said hologram recording medium for interference with said [object] light beams projected on said hologram recording medium [by means of said object beam projection step], wherein

each of said plurality of images corresponds to a respective element hologram, and

the number of said plurality of images is less than the number of element holograms included in said holographic stereogram.

11. Cancelled without prejudice or disclaimer.

12. (Amended) A holographic stereogram generation system for recording [3-D] three-dimensional image information on a hologram recording medium and generating a holographic stereogram, comprising:

an image generation system for generating a plurality of images in a parallax direction, including a spatial light

modulation means for separately displaying said plurality of images in said parallax direction ;

an object beam optical system for projecting light beams through [separately displaying a] said plurality of images generated by said image generation system and displayed on said spatial light modulations means in [a] the parallax direction, [superposing, projecting, and converging beams] to form a superposed image of said plurality of images [passing through the plurality of separately displayed images] on said holographic medium, and projecting images corresponding to the number of separations on said hologram recording medium; and

a reference beam optical system for projecting a reference beam on said hologram recording medium for interference with said image projected on said hologram recording medium by said object beam optical system, wherein

each of said plurality of images corresponds to a respective element hologram, and

the number of said plurality of images is less than the number of element holograms included in said holographic stereogram.